STEEL METHODS OF TESTIN

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OF

MACROSTRUCTURES.

GOS. 10243-75

(CMEA STANDARD 2837 - 81)

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STEEL METHODS OF TESTING AND ESTIMATION OF MACROSTRUCTURES

GOST 10243-75

SHEET	No. OF SHEETS
1	55

These standards pertains to forged and rolled carbon, alloyed and high alloyed steels and establish the methods of testing and standard scales for estimation of macrostructures, as well as classification of defects of macrostructures and fractures of bars and blanks of dia or thickness from 40 mm (the smaller side) to 250 mm (the bigger side) of cross section.

Upon agreement between the customer and supplier, the methods for manufacturing the macrotemplets and test pieces to be fractured which have been established by this standard may be pertained to blanks, forgings and articles of other sections and sizes. The estimation of macrostructures in these cases may be performed with the standard pieces of this standard, branch standards or specifications. Upon agreement of the customer with the supplier, the standard may be pertained to the steel made by the continuous casting method.

The standards for certain kinds of the steel products specify the necessity of the macrostructure test, number and places of cutting test pieces out of the length of rolled plate, sizes of test pieces after re-forging as well as norms for permissible defects and list of impermissible ones.

The standard has taken into account the requirements of the CMEA recommendations PC-3629-72 regarding standardizing.

As to the method of testing by etching, the standard completely complies with CMEA standard 2837-81.

1. GENERAL

1.1. The metal macrostructures are checked as follows:

- by etching of specially prepared test pieces in acids.

  The method is based on the difference in etching effects on non-defective metal and on areas having pores, segregation, non uniformity of structures and other defects.

- by fracture testing of specially prepared (including those subjected to additional heat treatment) test pieces.

  The method is based on the differences in fractures of areas having porosity, flakes, overheating, chippings and those free of the defects.

  The quality of metal is checked by fracture test:

  Instead of checking the etched test pieces, if it is stipulated in standards for this metal product.

- In addition to checking the etched test pieces, to check classification of macro defects as well as for research purposes.

1.2. The macrostructure of carbon structural steel (of carbon content upto 0.3%) is not checked by fracture test.

The estimation of macrotemplets and fractured pieces is performed by a naked eye. Two or four times magnification may be used to clarify the classification of defects.

2. SAMPLING AND MAKING OF TEST PIECES.

2.1. The macrostructure of metal is checked according to one of the following procedures:

2.1.1. Bars and blanks of size upto 140 mm st[illegible] (transverse sections).

2.1.2. Bars and blanks of size above 140 mm of re-forged or re-rolled test pieces, if standards or specifications do not specify the necessity of checking the entire section to 250 mm.

2.2. Number of test pieces and places of their cutting out along the length and section of the rolled plate (cast blank) are specified in standards and specifications for certain kinds of metal products.

If no instructions of this kind have been given, the test pieces are selected (at the steel plant) from the blanks corresponding to the most impure portions.

The markings on blanks and test pieces cut from them should comply with the markings of blanks under checking.

It's recommended:

a. When top pouring the metal, check the first and the last (as per time) ingots: when rising pouring

blanks from one ingot of the first and the last pourings.

If the stamp is absent, check any blanks of any ingots;

b. Metal of vacuum induction melting (ВИ) should be checked with a test piece taken from the riser area of every ingot;

в. Metal of vacuum arc (ВД), electron-beam (ЭЛ) plasma-arc (ПД, П) and electric slag (ШД) meltings - with test pieces cut from blanks corresponding to the upper and lower portions of one or two ingots from the melting batch;

c. Metal of double melting: vaccum - induction + vacuum arc (ВИ-ВД) electric slag + vacuum arc (ШД-ВД) and other, should be checked in compliance with the recommendations specified for the latter method of melting.

When checking the meltings sub divided into several batches according to the sizes, the test pieces are cut out of the blanks heving maximum sections. The success of the test may be pertained to all batches of this melting having a smaller size as well as to blanks having transverse dimensions which exceed those under checking by 20 mm max.

2.4. The pieces to be tested for revealing flakes are selected from any blanks after the whole cycle of cooling or heat treatment of every batch melting is over.

When the cooling conditions for the blanks of various sections are similar, the test pieces are cut from the blanks belonging to those of maximum sections in this melting. The test pieces and templates are cut across fibres with saws or gas cutting at a distance of not less than one diameter (side of square) from the blank edge.

In those cases when gas cutting is not allowed (specified by standards and specifications) the test piece is cut off right after rolling or forging when the blank is hot. The length of the test piece should be at least four diameters (sides of square). The test pieces are cooled and heat treated together with the metal of the melting batch under checking. The templates are cut out of the middle part of this test piece.

The metal may be checked for flakes:

- with longitudinal templates and fractures. In the latter case, the transverse templates should be notched, quinched and fractured.
- by ultrasonic flaw detection method.

2.5. The pieces to be tested for macrostructure are cut out as speified below:

2.5.1. The templates should be cut so that the section under checking is at a distance which prevents effects of cutting: heating resulting from cutting, crumbling by press, saw and so on.

2.5.2. To test the metal shaped as re-forged blanks, a length of atleast one dia. (or side of square) is cut and re-forged to suit dimension 90 to 140 mm unless otherwise specified in standards. The templates for testing should be cut out of the middle part of the forged test piece length.

2.5.3. The templates are cut perpendicularily to the direction of rolling or forging across the whole section of the blank, but in parallel to the direction of rolling or forging when checking for the macrostructure and flakes with the transverse test piece. In the latter case, the plane of future section should coincide or be close to the axial plane of the blank under checking.

The length of the longitudinal templates should be 100 to 150 mm.

2.5.4. The recommended height of the ~~traverse~~ [illegible] templates should be 15 to 40 mm.

2.5.5. If necessary, the test pieces cut from the large section blanks (bigger than of square of 200 mm and slabs) may be cut into pieces provided that the axial zone (drg. 1) is maintained. All parts of a test piece should be etched and estimated.

(Drg 1 is in page -34)

Drg. No. 1

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2.6. The surface of templates prior to etching should be subjected to cold machining, facing, planning, grinding. After the machining, the surface should be smooth and uniform, free of surface overpeening and grinding burn of metal. When arbitration testing takes place, the surface roughness of the machined templates should not exceed 20 μm GOST 2789-73.

2.7. The templates are ground at the metal hardness of BHN 388 max. (dia of impression is atleast 3.1 mm) While testing a steel having considerable inhomogenity of structure as well as that being supplied when having increased hardness, it's necessary to conduct sidening heat treatment of test pieces and templates.

2.8. The fracture test is performed on test pieces having transverse and longitudinal direction of fibres. If the fracture test must be carried out instead of etching test, the test pieces having the transverse direction of fibres are used; when testing by fracturing, the test pieces having the longitudinal direction of fibres are used in addition to the checking of macrostructure.

2.8.1. To check a supplied blank by fracturing cross fibres (or test pieces from such blanks), notching according to one of the methods shown in drawing 2 is done [illegible] page 2 of Dwg-2

The area of fracture should be not less than ½ of blank section area. A test piece or blank should be fractured at a maximum speed and by a great concentrated load which prevents crumbling the surface of fracture and formation of false splits.

2.5.4. To check a fracture along the fibres, special test pieces are cut or templates are used after etching and checking the macrostructure. The templates to be fractured are notched along the axial line or across the place of a defect but on reverse side relative to the macrosection plane. The depth and shape of the notch should gusrantee a straight fracture (free of crumbling) and its sufficient height: at least 10 mm for blanks of size 80 mm and more: and 5 mm for sizes smaller than 80 mm.

To reveal very fine defects, the templates are heated upto the temperature, which is not lower then that specified in standards and specifications, for heat treatment of test pieces while testing mechanical properties or hardness, and quinched in water.

3. EQUIPMENT, REAGENTS AND CONDITIONS OF ETCHING OF TEMPLATES

3.1. To etch the templates, those tanks and vessels should be used, which never react with the solutions used for etching.

3.2. Before etching, the templates should be cleaned from dirt and degreased if necessary.

The test pieces in the etching baths should not have a contact with each other by their surfaces under checking or with the tank walls.

The amount of the etching solution should ensure low rate of decrease in concentration of acid during etching.

The approximate amount of the solution should be as follows (in cm^3)

100 - for 10 cm^2 of the template area;

500 - for 100 cm^2 of the template area;

2000 - for 1000 cm^2 of the template area.

Prior to etching the test pieces should be heated upto 60 to 80°C, i.e. to the solution temperature.

3.3. The recommended reagents and etching conditions are specified in appendix 1. other reagents may

be used, provided that the results of etching are the same.

The reagents used should be clean, light, free of suspended particles and foam.

The etching conditions should protect from formation of false defects.

3.4. When using large tanks, test pieces of grades having similar chemical compositions may be etched simultaneously.

The time of etching should be long (within the limits recommended in appendix 1).

For alloyed and acid-resistant steels;

for metal having increased

while etching test pieces without heating;

while etching in less heated solution.

3.5. The etching of test pieces should provide for obtaining clearly revealed macrostructure, which allows to estimate it reliably when it is compared with the scales and photopictures.

3.6. If the metal is considerably etched (surface is getting darker, false porosity is formed over the entire surface, becomes rough) the tests are repeated with the same test pieces, after their surface layers are cut off to a depth of atleast 2 mm.

3.7. After etching in any reagent, the test pieces should be thoroughly rinsed in a running water and dried. In this case non metellic brushes are recommended to be used.

The test pieces intended for storage are recommended to be additionally treated with 10% alcohol solution of ammonium and rinsed in alcohol and then coated with a colourless varnish.

4. ESTIMATION OF ETCHED TEMPLATES AND FRACTURES.

4.1. Estimation of kind and degree of development of macrostructure defects is conducted by comparing the appearance of freshly etched test pieces with the standard pieces of scales of this standard (see appendix 2) or with pictures (see appendix 4) with a use of descriptions contained in appendices 3 and 4. To estimate the defects revealed in fracture correctly, the pictures and brief description specified in appendix 4 are used.

4.2. Each scale consists of five degrees. The scales specify and show the following kinds of macrostructure defects:

Scales N1 and 1a	-	Central porosity;
Scales N2 and 2a	-	Point like non uniformity;
Scales N3 3a and 3b	-	General spotted segregation
Scales N4 and 4a	-	on edge spotted segregation
Scales N5 and 5a	-	segregation square;
Scales N6 and 6a	-	Sub shrinkage segregation
Scale N7	-	Crust blisters
Scale N8	-	Intercrystallite cracks;
Scale N9	-	Layered crystallization;
Scale N10	-	Light stripe(contour).

The test pieces of blanks of 90 - 140 mm as well as those of reforged samples are estimated as per scales N1, 2, 3, 3b, 4, 5, 6, 7, 8, 9.

The test pieces of blanks of dimensions from 140 to 250 mm - as per scales N1a, 2a, 3a, 4a, 5a, 6a, 10a.

The subcrust blisters, intercrystallite cracks, layered crystallization in blanks of size from 140 to 250 mm are estimated as per scales N7, 8, 9 respectively. The light stripe (contour) in blank of size 90 to 140 mm is estimated as per scale N10a.

When estimating the blanks of above 250 mm or less than 90 mm, the defective areas should be respectively increased (for the blanks bigger than 250 mm) or decreased (for the blanks smaller than 90 mm) as compared with the scales, at the ratio corresponding the increase or decrease of the area of blank cross section to be checkdd. In this case, the degree of development of the defects is taken into account.

4.4. The degree of defects may be estimated both by whole numbers and halves (0.5; 1.5; and so on) Number 0.5 is applicable for estimation of template structures, if the degree of defects is one and a half or two times less than that of photopictures of standards of first numbers in corresponding scales.

When defects are absent, number 0 is given. If the development is great, number 5 should be

exceeded.

If several defects are present simultaneously, each defect is estimated and classified separately.

4.5. The degree of development of defects in fractures and on longitudinal macro templates is estimated by comparison of their appearance with the photopictures of special scales agreed between the supplier and customer.

4.6. While the metal macrostructure is estimated with the pictures (during arbitration tests), the latter should be legible, of true size. Scale should be specified.

4.7. If the results of the primary inspection of macrostructure are not satisfactory, the repeated tests are performed in the scope established by standards for these products.

If no instructions are given, the repeated test is recommended to be conducted according to one of the plans specified below:

a. with doubled number of test pieces.

b. with test pieces of defective blanks, or (if ingots are marked each) - from defective blanks, after defective portion of blanks is additionally cut off;

c. with test pieces from adjacent blanks, after grading defective blanks off.

d. with test pieces from every ingot or blank. When the case is extremely important or if the defects of new kind are revealed.

5. PRESENTATION OF TEST RESULTS

5.1. The macrostructure estimation results are entered in the test record and should specify the following:

- Grade of steel;
- Heat no;
- Designation of standard for supply;
- Section and dimension of blank under checking, mm
- number and index of blank;
- numbers of defectiveness;
  - Central porosity;
  - Point like non [illegible];
  - General spotted segregation;
  - on edge spotted segregation;
  - segregation square;
  - sub shrinkage segregation;
  - Sub crust blisters;
  - intercrystallite cracks;
  - layered crystallization;
  - light stripe (contour)
- defects non standardized by scales and surface defects revealed on transverse templates recorded in notes.

5.2. The metal quality certificate specifies "Suitable" or "complies with requirements".

Note :- These Drawings are only for reference. Actual Drawings may be different and shall be issued at the time of procurement

Appendix 1

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RECOMMENDED REAGENTS AND CONDITIONS OF ETCHING.

Grade of Steel	Composition of Reagent	Solution tempera-ture, °C.	Time of etching min	Remarks
(1)	(2)	(3)	(4)	(5)
	Reagent 1			
All grades of steel, except those specified below	Hydrochloric acid GOST 3118-67, 50% aqueous solution	60 - 80	5-- 45	-
	Reagent 2			
Corrosion proof, heat resistant and other steels of austenite class	Hydrochloric acid GOST 3118-67-100 ml. Nitric acid GOST 4461-67-10 ml; Water-100 ml.	60 - 70	5 - 10	-
	Reagent 3			
Corrosion proof, heat resistant and other steels of austenite class	Hydrochloric acid GOST 3118-67 - 100 ml. Nitric acid GOST 4461-67 - 100 ml. Water - 100 ml.	60 - 70	5 - 10	-

APPENDIX 1 CONTINUED

(1)	(2)	(3)	(4)	(5)
Corrosion proof heat resistant and other steels of austenite class.	**Reagent 4** Hydrochloric acid GOST 3118-67 - 100 ml. Nitric acid GOST 4461 - 67 - 100 ml. Water [illegible] Potassium bichromate GOST 4220-65-11.0 to 11.5 g.	20	5 - 10	- 8
Corrosion proof, heat resistant and other steels of austenite and ferrite classes	**Reagent 5** Hydrochloric acid GOST 3118-67 - 100 ml. Sulphuric acid GOST 4204-77 - 7 ml. Cupric Sulphate GOST 4165-78 - 30 g. or dehydrated cupric sulphate GOST 897-68 - 20 g.	20	15 - 25	Etching is recommended to be performed by wiping a cotton wetted in reagent-Rinse ground glass joint with water and 5 to 10% solution of potassium bichromate (as per GOST 4220-65)

Continuation of alteration for GOST 10243-75

Appendix 1

Replace the unit of measurement and references: ml for cm^3, GOST 3118-67 for GOST 3118-77, GOST 4461-67 for GOST 4461-77, GOST 4220-65 for GOST 4220-75, GOST 4204-66 for GOST 4204-77, GOST 4165-68 for GOST 4165-78.

Appendix 5

Replace refernces: GOST 6456-68 for GOST 6456-75, GOST 4204-66 for GOST 4204-77, GOST 10752-64 for GOST 10752-79, GOST 4328-66 for GOST 20-77, GOST 4215-66 for CMEA standard 223-75; exclude reference to GOST 897-68.

(VNIICNII, 1982)

Appendix 2

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SCALES OF MACROSTRUCTURES

(See the enclosure)

[as per A0 size drawing]

Appendix 3

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DESCRIPTION OF MACROSTRUCTURE AND DEFECTS ILLUSTRATED BY SCALES.

1. Central porosity

Shallow cavities failed to be welded when hot machining the ingot. The porosity is indicated on a macro-etchate as fine or seperate big dark spots-pores. The development of the defect (number) is determined according to the quantity, size of pores and area of test pieces affected by the porosity (scale N1 and 1A)

2. Segregation

Non-uniformity of some metal areas, regarding chemical composition, structure, non metal and geseous inclusions. There are classifications and estimation of four kinds of segregation.

2.1 Point like non uniformity, point like segregation - fine round dull points which can be intensively etched, which are located over the entire section of the test piece, excluding the extreme edge. The development of the defect (number) is basically determined by the quantity of points and condition of etched metal in them. Sizes of points and area of test piece affected by the points (scale N2 and 2 A)

The segregation is, sometimes, revealed in the longitudinal fracture, in the shape of stripes having more light crystalline structure.

2.2. Spotted segregation

Separate dark spots of different sizes and shapes. As per their location on test pieces, two kinds of spotted segregation are distinguished.

a. General spotted segregation

Spot located over the section of test piece, rather symmetrically to the axis of blank (scales N3 and 3a), or asymmetrically located spots of smaller sizes, but having greater difference in their structure from that of basic metal (scale 3b). The latter ones are generally revealed in the metal made in basic arc and electric slag furnaces.

b. On edge spotted segregation

Oval spots located along the faces of testpiece. The development of defect (number) depends on the quantity, visibility, sizes of spots and area of test piece affected by the spots. The depth of location of spots from the test piece surface is taken into account as well (scales N4 and N4a).

2.3. Segregation square or segregation circle

Contour of segregation depends on the shape of ingot. It has a shape of metal stripe (often located in the centre of radius or ¼ of square side) which is etched more intensively in comparison with the rest of section. As etching ability of metal in the stripe and seclusion of the contour grow up, the number of estimation goes up as well (Scales N5 and 5a).

2.4. Sub shrinkage segregation

dark, easily etched areas of metal in the centre of blanks. The no. grows as the size of spots and difference in etching ability of the middle portion and the rest of test piece are going up (scales N6 and 6a) The appearance of the dark spots may be due to carburizing of metal, which results from warming filling mixtures containing carbon.

To clarify the classification of defects e to reveal the segregation, it's recommended to conduct an additional check by the method of taking imprints according to distribution of sulphur - by the method of Baumann (appendix 5, para 2), as well as by etching the polished test pieces by the reagents of Oberhoffer, Klein and others. The method of taking imprints according to Wragg is applicable to establish the distribution of lead in the steel for research purposes.

5.0 Subcrust blisters

fine pores located close or on the surface of blank. The shape of the defect depends upon the depth of location: shaped as round, oval or rolled as thin "dashes". The degree of development of defect is estimated in numbers. As the quantity of the blisters in the test piece plane as well as the depth of their location grow up, the number goes up (scale N7)

4. Intercrystallite cranks

three or more anfractuous, thin, spider like stripes, directed aside, from the blank axis (scale N8). The number grows as the quantity and sizes of the cracks (their length and width) are growing up. The classification of the defect is checked by the fracture test. Lamination in the hardened fracture means that the determination was correct.

Etching of metal in the shape of a "spider" may occur due to structural non uniformity which is not considered as the reason for rejection. In this case, the test is recommended to be repeated after heat treatment, normalisation or annealing of test piece.

5. Layered crystallization

Layers of metal, in turns, in the shape of bright and dark stripes in most cases located next to the surface, or rarely - over the entire section. The number grows up, as the etching ability of stripes, their width and quantity and depth of locating are growing. (scale N9)

6. Light stripe (contour)

Relatively bright concentric stripe of metal of lower etching ability. The shape of the stripe (circle, square) depends on the shape of crystallizer. The number grows as the brightness and width of the stripe, closeness of contour and quantity of stripes are growing (Scale N10 a)

Appendix 4
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DESCRIPTION OF MACROSTRUCTURE AND DEFECTS ILLUSTRATED BY PICTURES

Defects revealed in fractures

1. Coarse rolled pores and blisters

Separate thread like stripes having distorted crystalline structure. The blisters may be lonely accompanied located all over the section in the middle or next to the blank surface (drg. 1, b)

2. Coarse spotted segregation

Wide stripes of another crystalline structure, often dark, located optionally over the blank section (Drg. 2)

3. Remainder of shrinkage cavity

Stripe in the axial zone, shaped as dark or light grey stripe with slag, having non crystalline structure or smoothed, lapped, oxided surface (drg. 3)

4. Sub shrinkage friability

One or several dark stripes having coarse laminated structure, often with pores and inclusions of slag.

5. Lamination

Wide strips having smoothened, crystalline, bright (distinctive from shrinkage cavity) structure in the axial zone but more rare - in the zone of edges. It is caused by intercrystalline cracks in the ingot

which are failed to be welded during the subsequent deformation (drg. 4a,б) [1' page 36]

After a deformation of great value takes place, separate bright (silvery) threads remain in the fracture.

6. Intercrystellite layers are revealed in the metal relatively slightly deformed as a fracture of non-uniform structure of three kinds.

6.1. Chippings

Areas of various shapes and sizes, located often in the zone of edges of blanks rolled of structural steel grades. The surface of chippings has more fine grained structure and light or dull hue (drg. 5а,б) depending on the grade of steel and conditions of checking the test piece.

6.2. Layered fractures

Shaped as more regularly alternating stripes having fine grained and ordinary (for this grade of steel) structures. These are distincted according to their location over the blank section.

--next to surface;

- in the zone of axis;
- over the entire section: depending on the grade of steel, modes of deformation, place of cutting the test pieces out for checking (drg. 5б) [Please see page 37]

7. Decarburised and ~~carburized~~ layers

In transverse fractures of bars, it differe from the grain size and structure hue: bright, coarse

grained - when decarburized (drg. 6), dull, fine grained when carburised (along the entire perimeter of bar or of its portion).

8. Naphtalene or rocky fractures

Result of intensive overheating of metal before deforming or during heat treatment.

Naphtalene fracture is considered to be a plane fracture having a distinctive shining on sections large grains which reflect the light in different way each (drg. 7a).

Rocky fracture is a dull one along the boundaries of large or fine grains which show their faces.

Unlike the naphtalene fracture, the ability of grain faces to reflect feebly depends on the direction of illumination. To reveal the rocky fracture sometimes it's required to determine the most favourable conditions for tempering the hardened test pieces.

Foliations, tears out, false laminations

Shapes, as narrow ~~cavities~~ cavities, projections, depressions (tongues) in the bars fractured in transverse direction, but some times - in longitudinal direction as well. These are formed when the most favourable shape of notch is not maintained the heat treatment conditions, prior to the fracture test and the rate of fracturing are not observed (drg. 8a, 8). The foliations (tears out) have nothing in common with the quality of the metal. This can be proved by

by testing the macro and micro structures of the same test piece at the place of foliation.

10. Black fracture

Continuous or shaped as separate sections (of various shapes) fracture coloured in dark grey or black. It can be found in high carbon, tool steel grades (drg. 9). [pl see page 28]

NOTE: The defects specified in paras 1 to 6 are more clearly revealed in the longitudinal fractures, those specified in paras 7 to 10 - in the transverse defects.

DEFECTS REVEALED IN MACROSECTIONS AND THEN IN FRACTURES

11. Non uniformity of macrostructures (titanic, ceric, zirconic) - locally highly etched metal shaped as points, dots, spots at places of ecumulation of non metallic inclusions of these elements (drg. 10 a,b). It may be located both in the axial or edge zones and over the entire section of the test piece. If it's highly developed, it is revealed in the longitudinal fracture (drg. 10b) It exists in steel containing titanium (more than 0.3%) excessive percent of cerium, zirconium or if the process of their introduction in the metal was wrong.)

12. Crusts (exogenous inclusions)

Next to the edge or over the section of the blank areas of different etching ability, different as to their shapes and sizes. These may be dark (drg. 11a,) or bright (drg. 11) depending on the place of location at the ingot height, chemical composition, temperature of formation and degree of saturation with gaseous and non metallic inclusions.

A lamination may emerge along the coarse crusts resulted after rolling the metal. The lamination is revealed in the hardened fracture in the shape of stripes having non crystalline structure (drg. 11).

13. Air holes (blisters, cavities)

Separate coarse and fine hollownesses, oval, round or stretched pores; these are located on the test piece section, as a rule, assymmetrically. These may be lonely and accompanied. These are formed when crystallization of metal, oversaturated with gases, including the cases when pouring conditions are violated.

14. Flakes

Thin an fractuous cracks of a length from 1 to 30 and longer. These are located at random on a portion or the whole section of the test piece, excluding the edge area (drg. 13). To classify the defect correctly, additionally checking of the fracture of the same test piece after hardening

Sometimes it is found in fractures.

17. Black spots (cracks, fissures)

Shaped as friable, capable of intensive etching inner zone or separate dark spots which often appear together with a crack or two - fissures parallel to faces of ingot (drg. 16a). In a longitudinal fracture these may appear as discontinuity of metal friable state; if at the initial stage of development - shaped as stripes having coarse grained structure and fissures (drg. 16b). The defects are emerged due to overheating and destruction while the inner zone of blanks is deformed.

16. "Starting boxes"

Hollow pieces, cubes of various size and shape, often located single along the rolling direction of ingot. These are formed by opening and partial welding of inner transverse thermite cracks (drg. 17) when visual inspection of blank surfaces takes place, these may not be revealed.

The additional feature is an absence of segregation of carbon, sulphur, phosphorous as well as non-metallic inclusions around the defects.

15. Inner fissures

Numerous transverse fissures located in chain along the axis of blank (drg. 18) these differe from the "Starting boxes" by smaller dimensions, greater quantity, tortous contour and crystalline structure of the fracture surface. These are formed when the

pressure for deformation of the ingot central portion is insufficient. These are natural for the steel having high resistance to deformation and low rate of re-crystallisation.

20. Forging cracks

Inside the axial zone. These may appear as a cross, one diagonal crack, two cracks or more directed from the axis of ingot towards sides (drg. 19). Unlike intercrystallite cracks, these are wider and straighter. These may be located in ingot optimally. In the fracture these appear as coarse oxidized laminations.

21. Cracks

Formed when conditions of preparation of the test pieces are violated/these are not taken into account when macrostructure is estimated.

21.1 Grinding cracks

Net of cracks or separate thin cracks of various directions and lengths. These are formed when the metal, having high hardness (more than 388 BHN), considerable brittleness and low conductivity of heat, is ground.

21.2. Etching cracks

Local excessive corrosion shaped as discontinued cracks, sometimes in the shape of a net, which are formed while etching the metal stressd by structural inversions or with overpeening caused by deformation.

insufficiently dressed and fettled.

26.2. Sections of poor etchingebility of metal, while contamination is not visible (drg. 25 b) - are formed, when the crystallization conditions for the lower portion of the ingots are violated, and found in the blanks if this portion of the ingots produced by the vacuum arc and electric slag melt-ings is not sufficiently cut off.

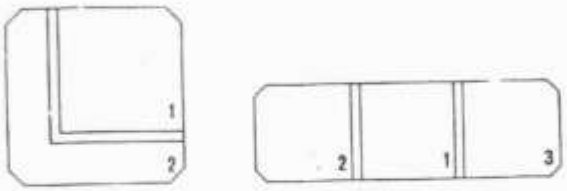
26.3. Local coarse non uniformity (electric breakdow) - is accompanied with blisters, air holes (drg. 25) or distortion of the shapes of other defects (drg. 25). In the last case, it occurs when the sequence of crystallisation is wrong. The defects occur due to poor continuity of the lining slag because of electric breakdowns which have taken place during the electric slag melting. An additional checking of the test piece, having the longitudinal direction of fibres, is recommended.

26. Corner cracks

Shaped as one narrow stripes or more located in the corner zones of the blank or partially displaced towards one of the faces (drg. 25). These takes place when the conditions of deoxidation and pouring the metal are violated, when the moulds have corners which are rounded wrongly etc.

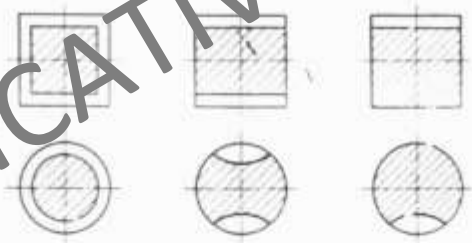
Note :- These Drawings are only for reference. Actual Drawings may be different and shall be issued at the time of procurement

Note :- These Drawings are only for reference. Actual Drawings may be different and shall be issued at the time of procurement



Черт. 1 Fig. 1.

[Please refer page-7]



Two-Side notch

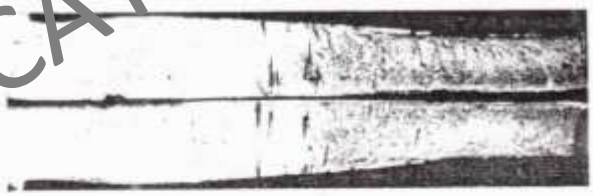
Single-Side notch

Черт. 2
Fig. 2.

[Please refer page-8]

Note :- These Drawings are only for reference. Actual Drawings may be different and shall be issued at the time of procurement

1 Coarse Pitted Pores and



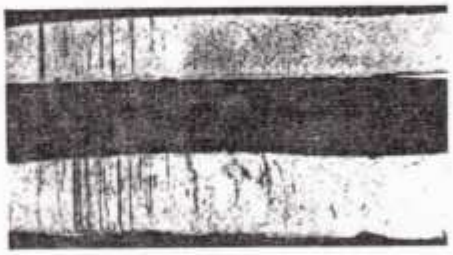


Fig. 1

36

Note :- These Drawings are only for reference. Actual Drawings may be different and shall be issued at the time of procurement

Стр. 12 ГОСТ 10243—75

(5) Lamination
Расслоение

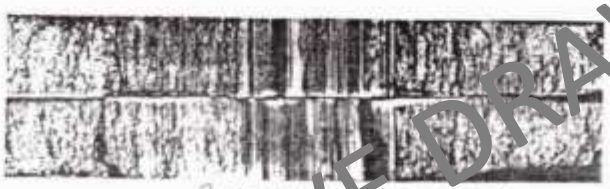


Fig 4.

Мелкокристаллитные прослойки

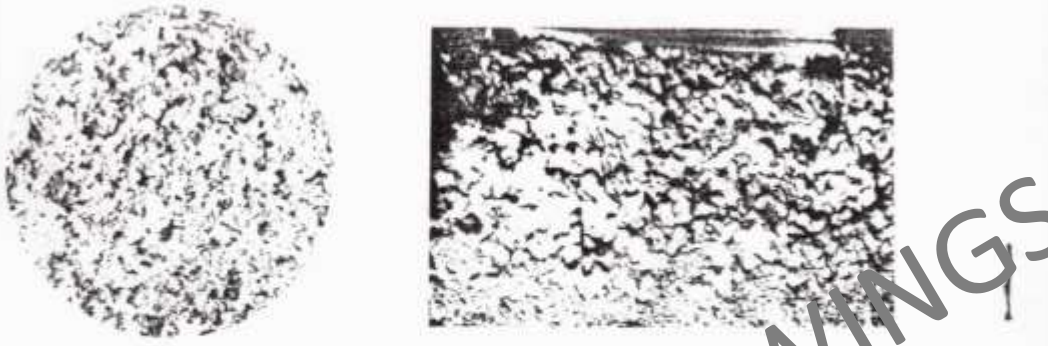
Fig – 5

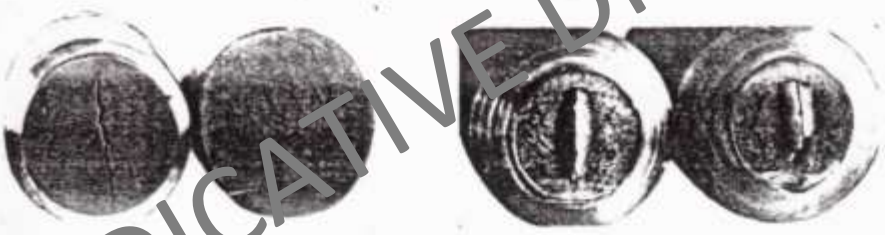
Chippings of bright fine (Colour)

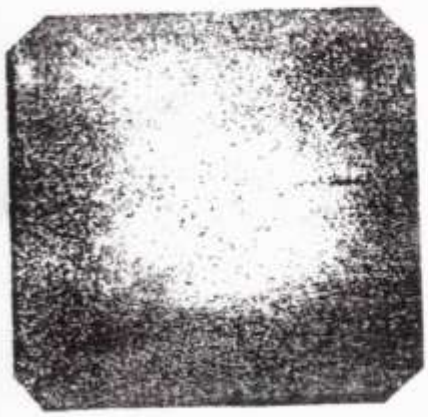
Chippings (areas) of dull fine (Colour)

(37)

Note :- These Drawings are only for reference. Actual Drawings may be different and shall be issued at the time of procurement





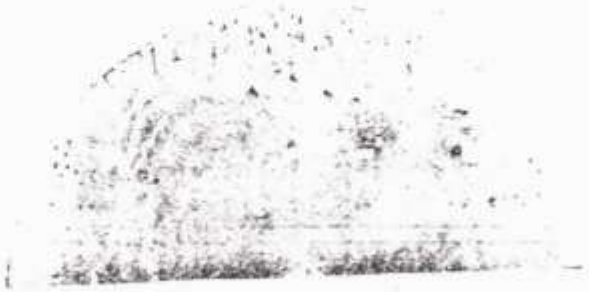


Корочки (вышелушенные включения)

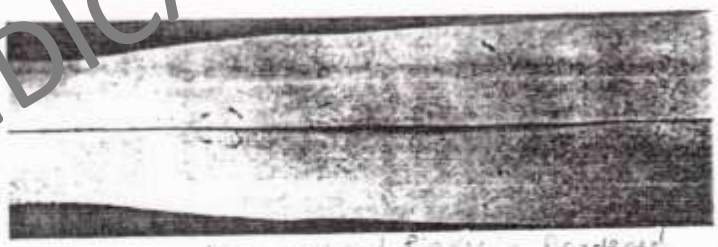
40

Note :- These Drawings are only for reference. Actual Drawings may be different and shall be issued at the time of procurement

Стр. 16 ГОСТ 10243—75



41

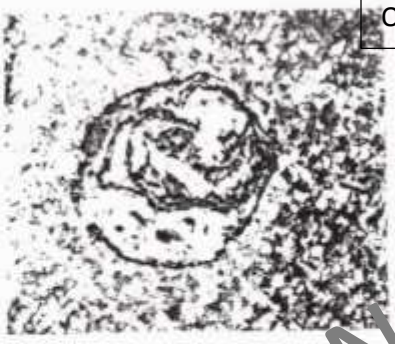


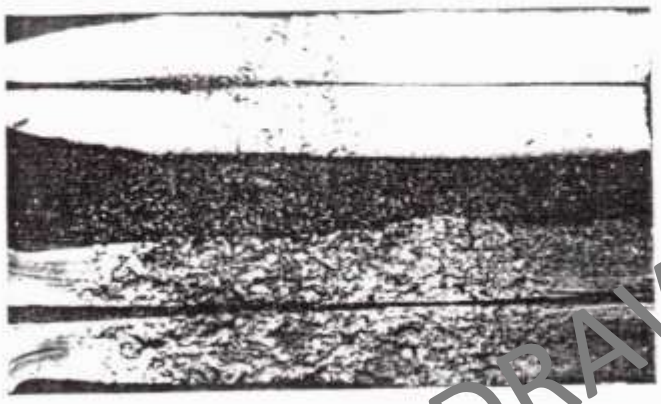
of ferrosilicium

of Slag

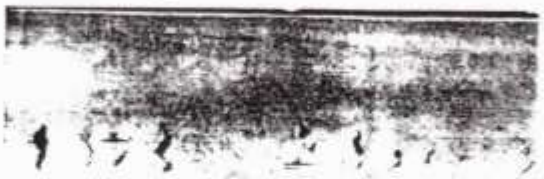
(44)

Note :- These Drawings are only for reference. Actual Drawings may be different and shall be issued at the time of procurement





Внутренние разрывы

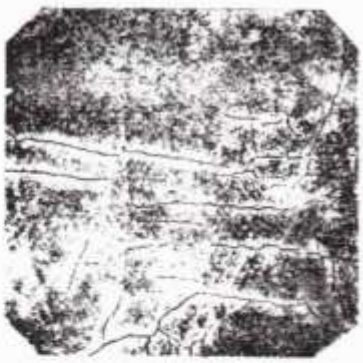


Черт. 18

Корочные трещины

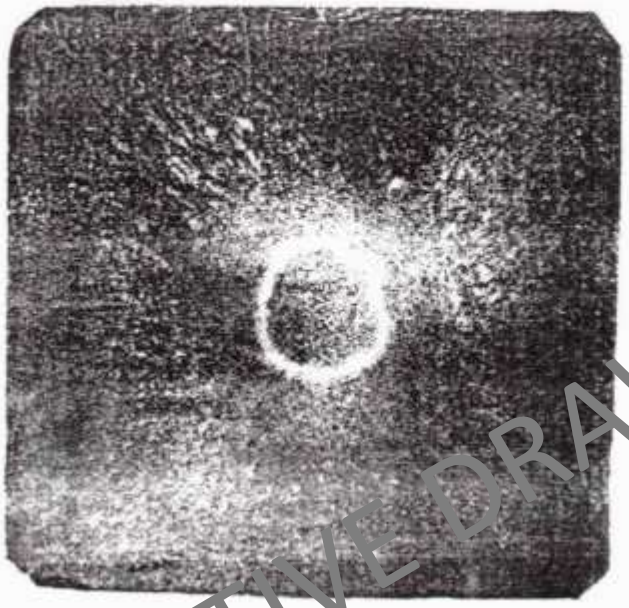
Черт. 19

Шлифовочно-травильные трещины

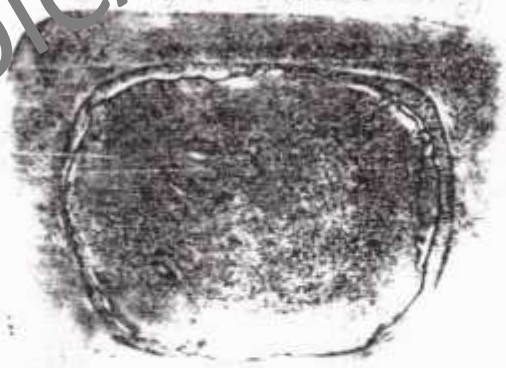


Черт. 20

Note :- These Drawings are only for reference. Actual Drawings may be different and shall be issued at the time of procurement



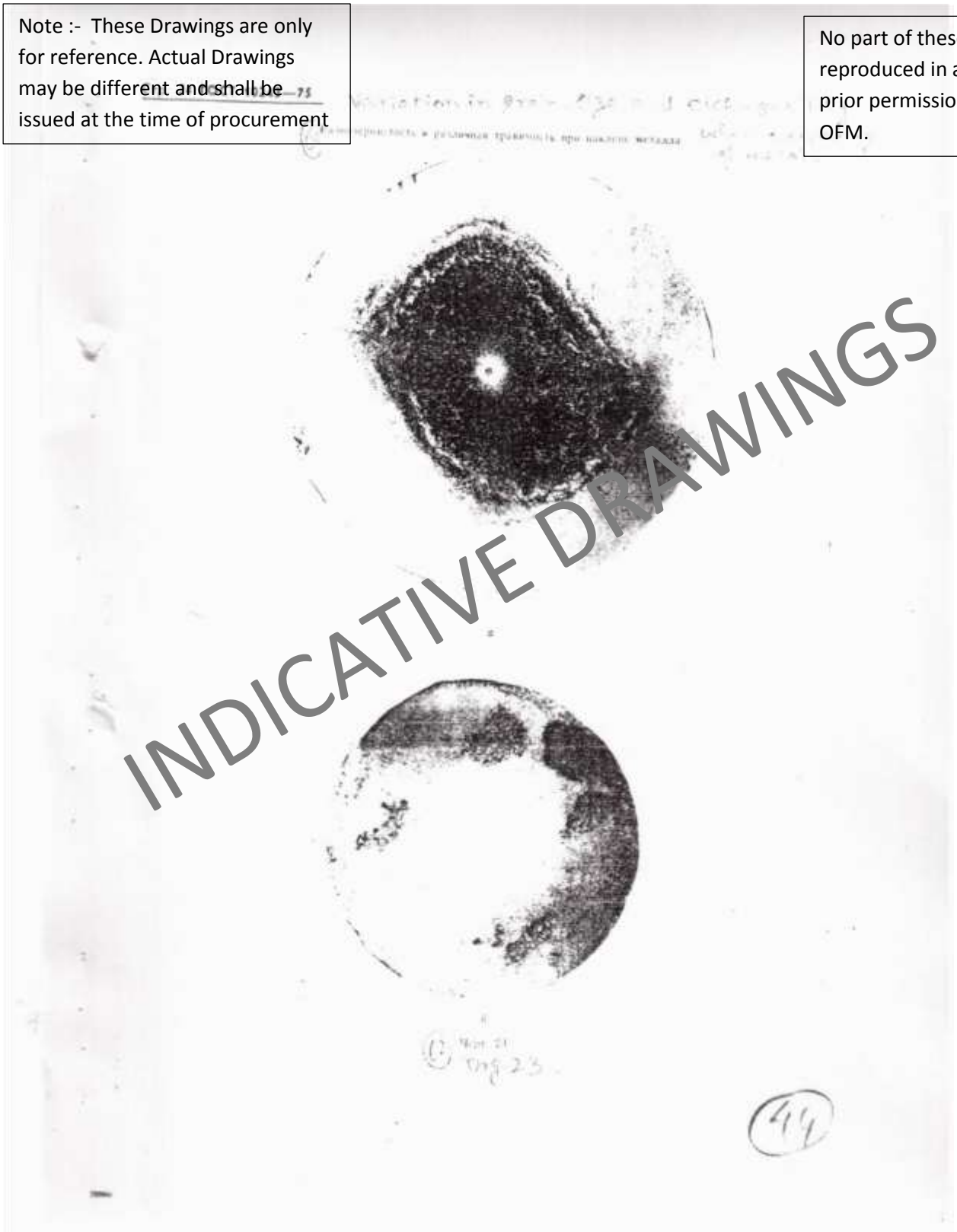
Черт 21 Dwg R1

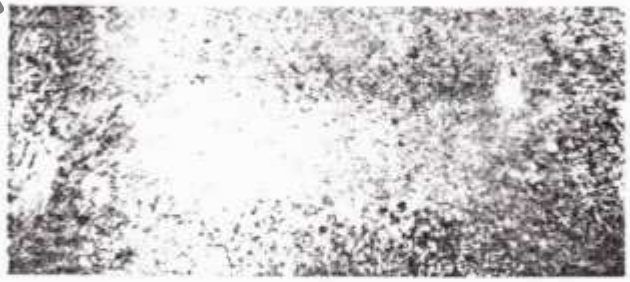


Черт 22
Dwg. 22

48

Note :- These Drawings are only for reference. Actual Drawings may be different and shall be issued at the time of procurement





Sections of poor etchingability without visible non-luminations.

(51)

Appendix 5
Compulsory

Inspection of chemical non-uniformity of steel by method of prints.

1. Method of sulphur print (Baumann print)

1.1. To take the print slowing the distribution of sulphur in the metal, the templates are annealed, planned or spot faced, then these are ground till the tool marks resalted from the previous working disappear and polished with emery paper N12 and 8 as per GOST 6456-68. The test pieces are carefully wiped from dust and greasy spots (it's recommended to use the denatured alcohol for the degreasing).

1.2. When taking the print from the high sulphurous (automatic) steels, the template are preliminarily wiped with a cotton wool wetted in 5% solution of sulphuric acid GOST 4204-66. In this case, the products of the initial reaction are removed.

1.3. The prints are taken on a photographic paper of the size which corresponds to that of the template (unibron GOST 10752-64). The sheets of the paper are soaked for 5.8 min, in the light, in 5% solution of the sulphuric acid (GOST 4204-66). To remove the excessive solution, the paper is slightly dried with a filtering paper and put on the template surface by the side of emulsion. The paper opposite side is continuously rolled with a rubber roller or cotton wool till gas bubbles generated during reactions are completely off.

The prints are taken at a temperature of about 200°C for 3 to 15 min, depending on the alloy and sulphur contents in the steel. The print is considered as prepared if the photographic paper gets darker from light brown (if the steel is allowed and contains less sulphur) to dark brown (if the steel is a carbon steel and has higher contents of sulphur as well as phosphorus), at places where sulphurous inclusions are accumulated, the photographic paper is the darkest in compliance with the amount of silver sulfide generated here.

1.4. The prepared print is carefully rinsed in the flowing water and processed with the hypo (the solution of sodium thiosulphate GOST 4215-66) for 20 to 30 minutes. Then it is rinsed again, dried and an inscription is made on the jar.

1.5. To take another print, the test piece surface is ground off by atleast 0.3 mm.

2. Method of revealing the presence and accumulations of lead (wragg method).

2.1. The template surface is ground, degreased and put into 10% solution of the ammonium persulphate. The template is being kept in till grey colouration is obtained, then rinsed in the running water till the grey deposit is off, and dried. The bromide silver photographic paper (uniBrom GOST 10752-64) is damped in the ~~xxxxxxx~~ sodium thiosulphate GOST 4215-66, in the darkness, to remove the silver sulphates. In

7 to 10 minutes, the paper is out, rinsed in the running water and dried. Before the print is taken, the prepared photographic paper is soaked in 5% aqueous solution of the caustic soda (sodium hydroxide GOST 4328-66), for 5 to 7 minutes, then slightly dried with a filtering paper and put on the test piece by the side of emulsion. The close contact of the photographic paper with the test piece surface is ensured by wiping with a cotton wool for 5 minutes (provided the paper remains at the same place).

2.2. The prepared print is immersed in 5% solution of sodium sulphide GOST 2053-66 for 10 to 15 seconds. The print is rinsed, dried, inscribed and captured if necessary. If the lead is present in the steel, the print is coloured in light brown with dark spots at places of segregation. If the lead is absent, the paper colour remains unchangeable. To take another print, the test piece surface is prepared again.

2.3. The prints obtained according to the both methods are compared with the factory standard pieces or by description and specifying the type of distribution of the sulphur or lead. For example, uniform or non-uniform; shaped as a continuous square on contour; in the axial or edge zones, etc.,